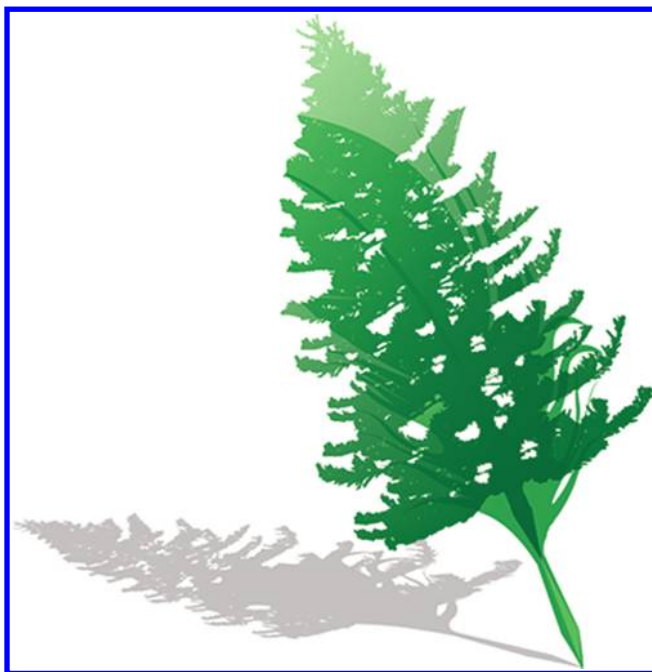


Sustainable Waste and Materials Management: National Policy and Global Perspective

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Waste generation and resource shortages have long been recognized as two of the greatest challenges human society is facing. In the early 1970s, the Club of Rome, a group of pioneering global thinkers, predicted in their milestone book *The Limits to Growth* that “if the present growth trends in world population...pollution ... and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years”. Since the 1970s, “sustainability” has become a key word in modern culture and has drawn a massive increase of attention. Many countries now consider sustainability a top priority of their national policies on waste and materials management. However, these policies tend to focus on each individual country and therefore may lack a global perspective.

The United Kingdom (UK) Department for Environment, Food and Rural Affairs (Defra), in a White Paper entitled “Government Review of Waste Policy in England 2011” published June 14, 2011, sets out actions to achieve an ambitious goal of “zero waste economy”. This commitment may be partly attributed to England’s recent success in boosting its waste recycling rate. In 2010/11, England’s household waste recycling rate reached 40%, representing a significant increase from 11% in 2000/01. The commercial and industrial recycling rate is 52%, up from 42% in 2002/03. This increase of recycling rate is astonishing when compared to that in the United States where the municipal solid waste recycling rate only increased by

5% over a decade, reaching 34% in 2010. A large portion of UK’s recycled materials are exported to other countries, primarily countries in the Far East. Currently the UK exports 15 million tonnes of recycled materials, which is equivalent to approximately 32% of the total household and commercial waste.

While cheering for greatly improved recycling practice in the UK, we may ignore certain adverse effects associated with it, for instance, waste and contamination transfer. The UK is exporting 80% of its low-grade mixed papers, but only 20% of its high grade paper.¹ Because low-grade mixed paper tends to carry a larger percentage of unusable content, a significant portion of recycled content may end up as waste in importing countries. This issue intensifies as recycling rate increases because paper fibers become too short for paper-making after six times of reuse.² As Figure 1 shows, approximately 6% of recycled paper fiber may be unusable in paper-making when recycling rate reaches 50%, but nearly 20% could be unusable if recycling rate reaches 75%. In addition, low-grade mixed papers contain various contaminants that end up in polluted wastewater. Due to less stringent environmental safeguards at export destinations, this can lead to a wider spread of pollution and more exposure to the population. The most notable example of contamination transfer is in the recycling of e-waste. According to a 2005 report by the United Nations Environmental Programme, about 50–80% of e-waste collected in developed countries ends up in developing countries. A 2007 study by Wong et al. examined the contamination caused by e-waste recycling in Guiyu town in Southeast China, where over 200 individual workshops and nearly 100,000 migrant laborers worked on e-waste recycling. Toxic pollutants were found in Guiyu’s air, soil, and water, at concentrations up to hundreds of times of those reported for U.S. urban areas and up to thousands of times of background soil values reported in literature.³

Another often overlooked factor in the status quo recycling practice is emission from overseas transportation and processing. A recent meta-analysis shows that paper recycling can have a higher carbon footprint than incineration in 5 out of 15 scenarios, but “wins” in the remaining 10 scenarios.¹ However, these existing studies, including a comprehensive study by the USEPA, have all assumed domestic transportation and processing of recyclables. This is understandable because data may not be available to allow for life cycle analysis that involves both exporting and importing countries, especially considering numerous small to middle sized paper mills exist in importing countries like China, and their emission as well as

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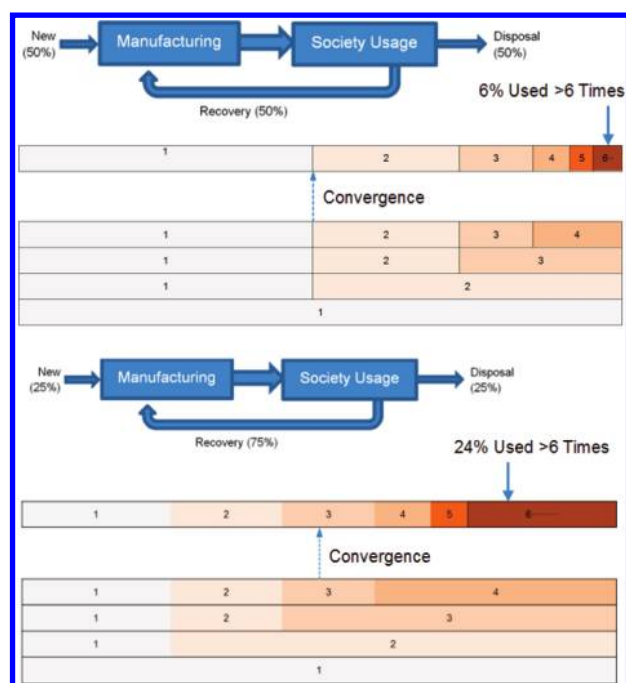


Figure 1. Simplified model showing that unusable paper fiber content converges at 6% at a recycling rate of 50%, and the unusable content increases to 24% at a recycling rate of 75% (Note: this simplified model does not account for impurities and small fibers that are removed during the repulping process).

avoided emission (i.e., due to the use of recyclables versus virgin fibers) can be difficult to quantify. Nevertheless, we believe this research gap should and can be filled. In addition, when the UK government makes its efforts to reach England's goal of reducing 10 million tonnes of CO₂ equivalent by 2020 in waste management, it is important to account for additional life-cycle impacts associated with the exported recyclables.

Lastly, the exported recyclables can potentially distort domestic recycling systems of the importing countries. China is the destination of over 60% of UK's exported waste paper and nearly 90% of recovered plastics;⁴ however, China's domestic waste recycling rate is lower than most other countries.⁵ The low recycling rate in China can be partly attributed to the large amount of recyclable materials imported from developed countries. From another perspective, the landfill tax imposed in the UK, which is to be increased to £80/tonne in 2014/15, is equivalent to a subsidy to recycling that can potentially distort the recycling market in China. An indirect but more profound consequence of this distorted market may be a social norm and behavior pattern that do not support sustainable usage and recycling. Combined with the fast growing economy and a huge population, a low domestic recycling rate in China could present a risk to the sustainable development of the human society as a whole.

Waste recycling has become a global business, and therefore the potential adverse effects described above can only be addressed with concerted effort from both exporting and importing countries. As many environmental problems have a trans-boundary nature, policy makers need to employ life cycle approaches that are based on global scale system boundaries. For instance, from a global perspective, sustainable waste and materials management policies in developed countries like the UK and the U.S. need to not only encourage the collection of more recyclables, but also promote domestic usage of collected

recyclables. By doing so, significant environmental benefits can be achieved.

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Notes

The authors declare no competing financial interest.

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